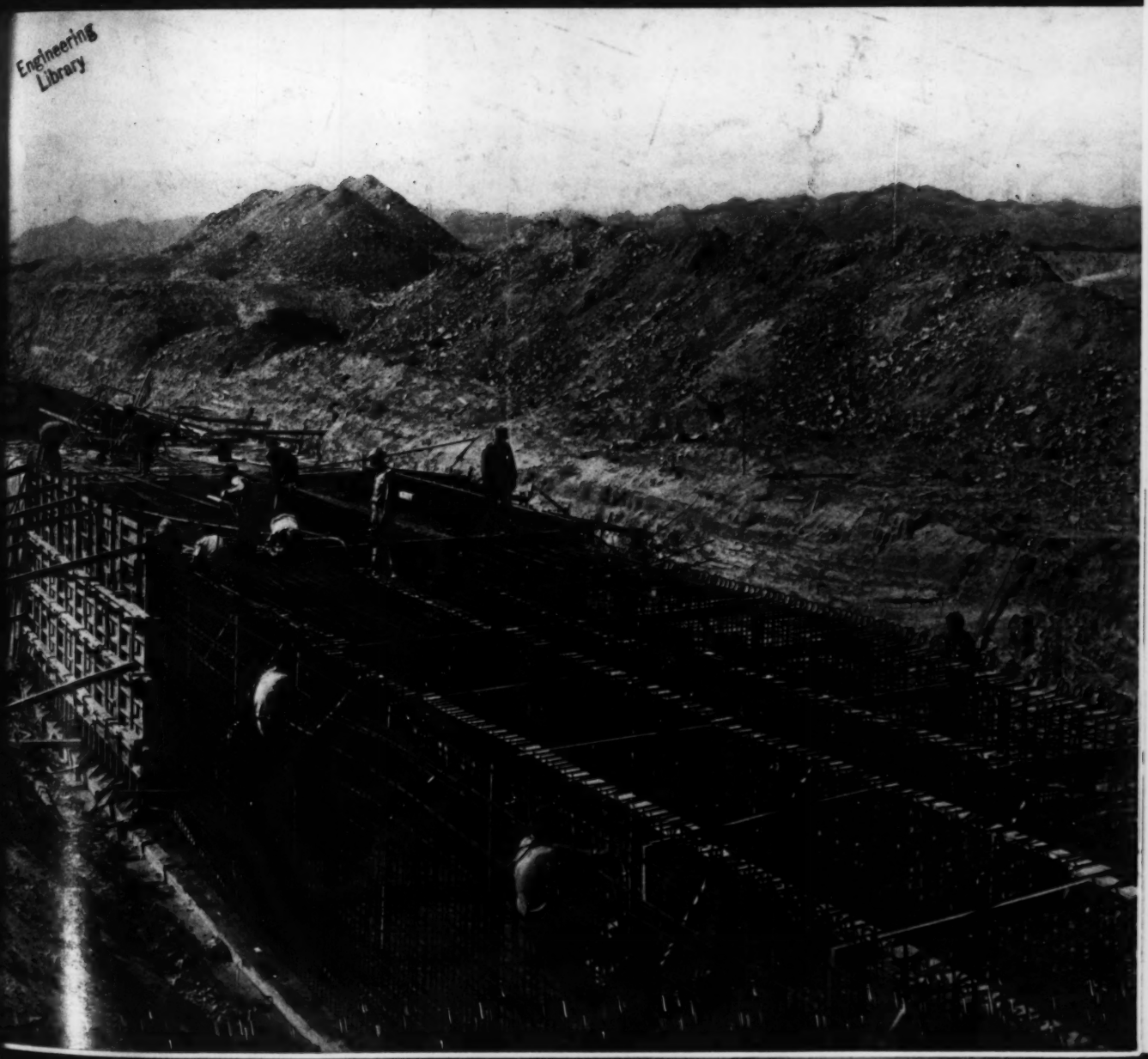
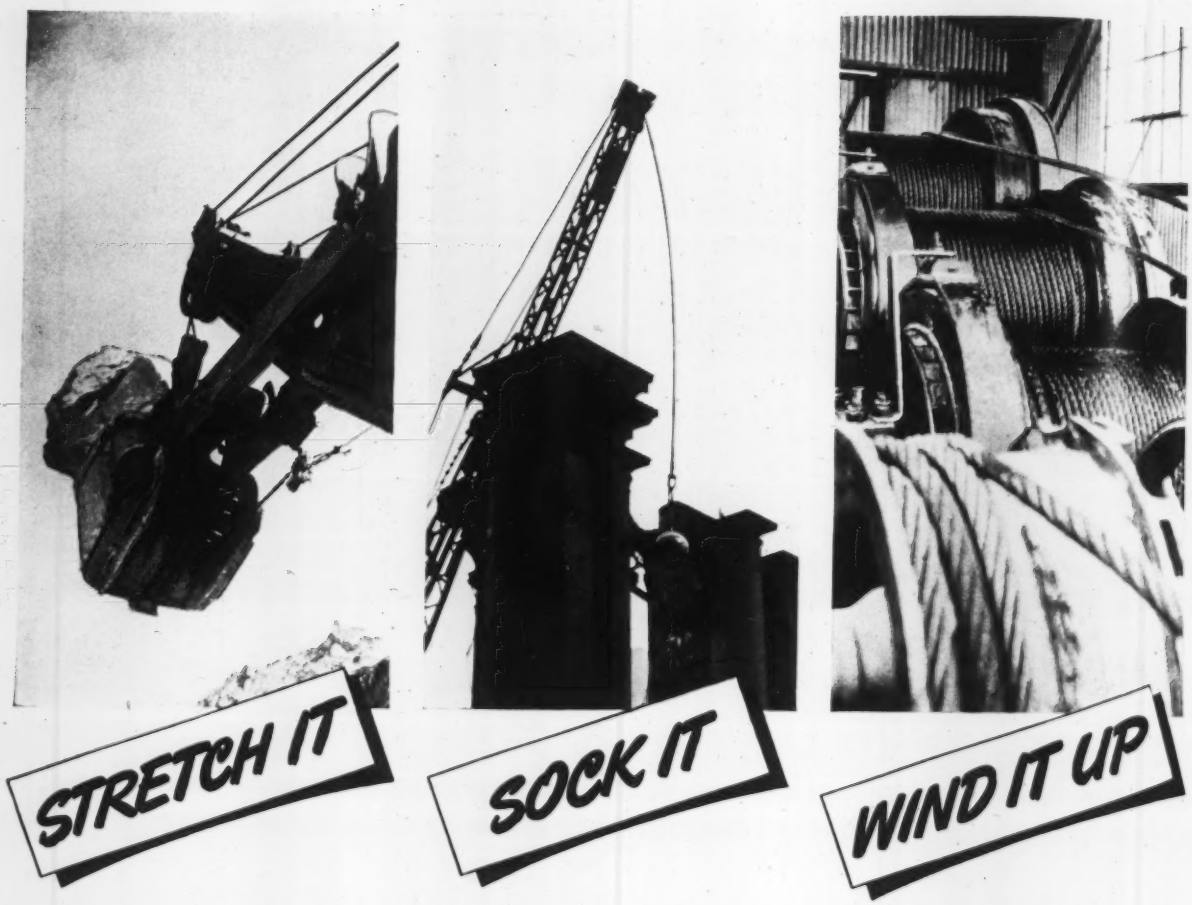
ENGINEERING NEWS-RECORD

Coachella branch work continues as All-American Canal goes into service—*See page 4*





. . . Bethlehem Purple Strand

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BETHLEHEM STEEL COMPANY

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The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • SEPTEMBER 5, 1940

Rush defense bill as Army construction needs rise

New contracts let include $14,215,000 ammunition loading plant and $7,500,000 of barracks. More airplane factories are also in the offing

Under the lash of critics who charge unnecessary delay, the tempo of defense construction activity has been noticeably spurred in Congress and in the various defense agencies over the past 10 days.

With scarcely a letup for the Labor Day holiday, the War and Navy departments rushed several projects to the point of announcement. Among them were a $14,215,000 ammunition loading plant; more than $7,500,000 for temporary housing at army posts; and award of tremendous airplane contracts which foreshadow considerable construction work for private plant expansion.

The Senate completed action on the $5,133,000,000 "total defense" appropriation bill, which had already been passed by the House. The bill, following approval by the House of the Senate changes and signing by the President, will release funds for the bulk of military construction now envisioned under the defense program.

More for munitions and housing

Major construction items in the bill are $700,000,000 for government munitions projects, and $100,000,000 for defense housing. The housing item was inserted in the bill in the Senate, as was $10,000,000—half in cash and half in authorization—for a new graving dock at New York.

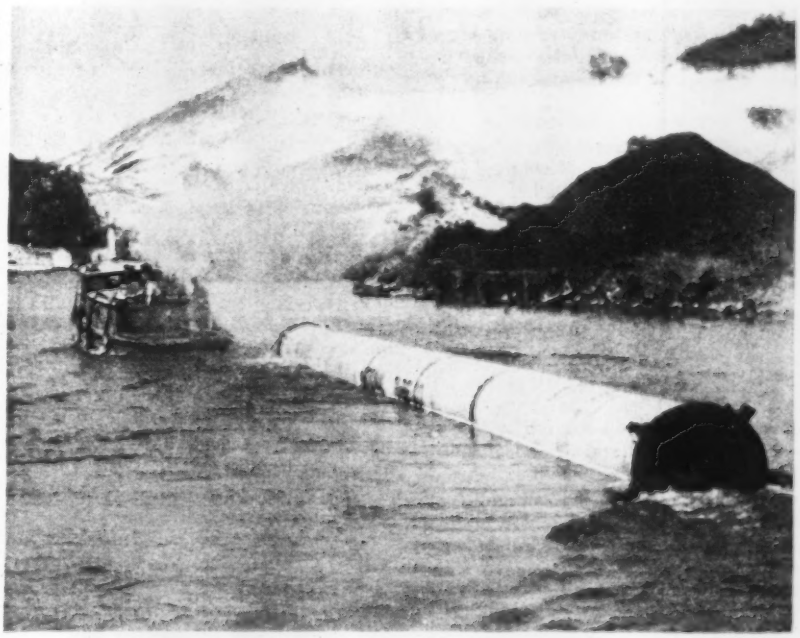
Although well weighted down with construction money, "the total defense" bill does not carry funds for constructing cantonments to accommodate conscriptees and national guardsmen who will be called to the colors in the near future. As soon as the conscription bill is enacted, the Army is slated to submit a billion dollar request to Congress to pay, house, transport and feed the nation's new army. In this bill will be an estimated $60,000,000 or $70,000,000 for temporary housing at army posts.

In anticipation of this money, President Roosevelt has already allocated $29,000,000 out of his lump sum defense appropriation to start the cantonment building drive, and the War Department made use of a part of the $29,000,000 during the week for two awards for temporary housing—a $5,531,000 contract to George A. Fuller, Inc., of Philadelphia, for frame buildings at Fort Dix; and a $2,025,350 contract to Owen-Ames-Kimball Co., Grand Rapids, Michigan, for temporary buildings at Camp Custer, Mich. Several other $2,000,000 barracks jobs had been let previously.

The Camp Dix job involves construction of 827 buildings to house National Guardsmen, and 25 buildings—all two-story frame—for the recruit reception center. It is a 90-day project and will employ at least 4,000 civilians.

The Army's new ammunition loading plant will be constructed near Ravenna, Ohio, on a 17,000 acre tract under a fixed-fee contract with the Atlas Powder Co. The project will require 10 months for completion. It will be composed of a "very great number" of small buildings, widely separated for safety. The buildings will be of reinforced concrete construction. Wilbur Watson & Associates, of Cleveland, has been retained by Atlas as the designer.

Recent award of tremendous airplane contracts is of special interest in construction circles. Although the money was devoted to orders, rather than proj-



An unusual ride for steel water pipe

Steel pipe required for the 16,000 ft., 54 in. intake to supply Lake Michigan water for Grand Rapids, Mich., is being floated to the site where needed in 120 ft. lengths. The pipe is transported to Holland, Mich., in 20-ft. lengths where three of them are joined before being rolled into the water. With ends bulkheaded tugs tow them out into the lake.

For details of the $12,100,000 project see ENR, March 28, 1940, p. 448.

ects, nevertheless it became apparent that considerable construction work would be necessary to enlarge plant capacity to turn out the orders. For instance, United Aircraft Corp. has announced that it will have to build additional facilities costing $2,500,000 to turn out the $160,000,000 government order for 17,000 Pratt & Whitney engines for the Army and Navy.

The $2,500,000 addition will comprise more than 400,000 sq. ft. of manufacturing area located to the east of the present Pratt & Whitney plant at East Hartford. It will be financed by the company although the Navy will furnish from $7,000,000 to $8,000,000 of machine tools for use in the factory.

This illustrates the extent to which non-construction defense funds are beginning to stimulate private construction—construction which is not reflected directly, of course, in any compilation of government building activities.

Moles hold summer meeting on Long Island

When the Moles, an organization with membership limited to men now or formerly engaged in tunnel, subway, marine or other heavy construction, held their third annual clambake at a north shore resort on Long Island, Aug. 21, about 400 contractors and engineers were present. The meeting began with a buffet luncheon, to continue with an afternoon of sports and an evening of sociability and entertainment.

At the president's table, where there were no speakers, were left to right: Alex M. Stagg, materials dealer of Jersey City; Ralph Atwater, Schultz Dredging Co., Hoboken, N. J.; Ray Spooner, New York City contractor and president of the organization; Gerald Crystal of the Carleton Co., New York; and Albert V. Sielke, consulting engineer of New York. Atwater was in general charge with Alfred Warwick, Long Island City, supervising sports.

WASHINGTON HIGHLIGHTS

JACOB CRANE, assistant administrator of the United States Housing Authority, has resigned to become assistant to Charles F. Palmer, defense housing coordinator for the President's advisory defense commission. Crane worked on U. S. Housing Corp. projects during 1918-1919 and now is assisting in working out a defense housing project for the present emergency. He says that defense housing plans are rapidly shaping up.

A BILL AUTHORIZING construction of a $27,000,000 bridge across the Straits of Mackinac, to connect Michigan's two peninsulas, is finally headed toward passage by Congress following an agreement on Senate-House differences. The House bill grants authority to build the bridge to the state of Michigan, while the Senate bill would delegate the job to the Mackinac Straits Bridge Authority, a creature of the state legislature. Under the agreement by which the bill went to conference, the question of which agency will do the job is put up to the state legislature. The legislature will have to determine whether the state will do it, or the bridge authority created by a prior legislature. Congressional differences over the project were an outcropping of disagreements over cost, type of bonds to be issued and other locally-discussed considerations.

THOMAS J. FORDE, who has been in charge of the federal government's emergency buying in the state of New York for five years, has been made chief procurement officer and expediter for the Army's construction work. He has just taken over his new duties in the construction division of the Quartermaster Corps and there will attempt to speed up procurement for all the Army's field construction under the expansion program. One of his first big jobs will be to set up a smooth-running procurement machine for the Army's cantonment program, which entails erection of temporary housing at some 34 army posts.

Forde is doing for the Army the same job performed in the World War by his former associate, Robert E. Hamilton, now vice-president of Stone-Webster Engineering Company. Forde was Hamilton's assistant in the firm before the latter went to Washington in 1917 to coordinate construction procurement. Although Forde did not accompany Hamilton to Washington, he did join him later at Hogg Island as an assistant, when Hamilton was placed in charge of purchases there.

THE POLITICAL FIREWORKS that lit up the awarding of fee contracts to Robert & Co., Inc. of Atlanta, for engineering and architecural services on Bureau of Yards and Docks work, while not surprising, considering Mr. Robert's position as secretary of the Democratic National Committee, are considered by no one to suggest that political pressure played a part in securing the jobs. Rear Admiral Ben Moreell, chief of the bureau, is rated as one of the most capable and independent officials in Washington and his integrity is unquestioned. To get the job done in the quickest, most efficient and economical manner, with complete disregard of political consequences, has been characteristic of his office from the beginning, say those in a position to know. The rapidity with which work has been let to contract and the low fee percentages obtained reinforce this view. Robert & Co.'s fees are slightly over $925,000, but there are others whose fees are large also, for example, Albert Kahn, Inc., Detroit, $660,000; Frederic R. Harris, New York, $620,000; Jaros, Baum & Bolles, New York, $125,000; and Giffels & Vallet, Inc., Detroit, $120,000. There is probably as much Republican as there is Democratic sentiment in these firms.

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California buys bridges

The California Toll Bridge Authority voted Aug. 24 to purchase from the American Toll Bridge Co. the Carquinez and Antioch bridges for $6,392,200 and to reduce the 50-cent toll on each structure to 30 cents. The state will take over the structures about Sept. 15.

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PRA demands defense priority for federal-aid work

Oklahoma's 1941 proposed program rejected because projects were not concentrated on strategic roads

Pending the passage of special highway legislation and appropriations for national defense, the Public Roads Administration apparently has started to wield a "big stick" over state highway departments to force them, where necessary, to give every consideration to defense in programming their road work for federal-aid funds.

Evidence of this came recently when Public Roads Commissioner Thomas H. MacDonald rejected Oklahoma's proposed $5,057,918 construction program for the current fiscal year, on the grounds that little, if any attention had been paid to defense and traffic flow in mapping the program.

PRA officials let it be known that they would do the same with other state programs if considerations other than defense and traffic density appear to predominate.

Oklahoma had belatedly submitted its 1941 program, which consisted of some 30 projects scattered throughout the state and not concentrated along the main highways designated by the War Department as part of the nation's 80,000-mile strategic roadway system.

At present, the PRA must rely on this veto power over the state departments to enforce defense priority, but already several things are in the offing to increase and broaden its defense power. For example, the Hayden-Cartwright federal-aid highway bill for the fiscal years 1942 and '43 gives PRA optional authority to grant priority to defense projects in passing upon use of a state's unallocated balance of federal-aid funds.

However, before this provision can take effect on next July 1, which is the start of the 1942 fiscal year, a new national defense highway bill likely will have been placed on the statute books. This new legislation, which is now in the making, may give PRA more than mere veto or optional power in forcing the States to accent defense roadwork, it is said.

In any event, PRA probably will receive adequate defense highway funds with which to initiate projects of an urgent defense nature. With its own project money, PRA could proceed with construction of these projects, without having to persuade a state highway department to include them in their regular federal-aid programs. But until all this comes to pass, PRA will have to continue to rely upon its veto power.

Bailey Photo

Addition to the Houston skyline

Rapidly nearing completion at Houston, Texas, is this 16-floor plus 3-story-tower office building. Some 300 ft. high and costing $2,250,000 it is faced with Indiana limestone and nickel trim, and is air conditioned and soundproofed throughout.

John and Drew Eberson of New York City are the architects, Weiskopf & Pickworth, New York, the structural and foundation engineers, and Charles Leopold, Philadelphia, the engineer for mechanical facilities. At Houston, Harry Weaver represents the architects and James Miller is superintendent for American Construction Co., Houston, the general contractor.

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Iowa State engineering grads well employed

Don S. Stevens, personnel officer of the engineering division at Iowa State College, has made known that all but 12, or 95 per cent of the college's 1940 engineering graduates have received employment. "Every man in the mechanical, electrical, architectural, civil, agricultural and mining engineering department has been placed," Stevens reports.

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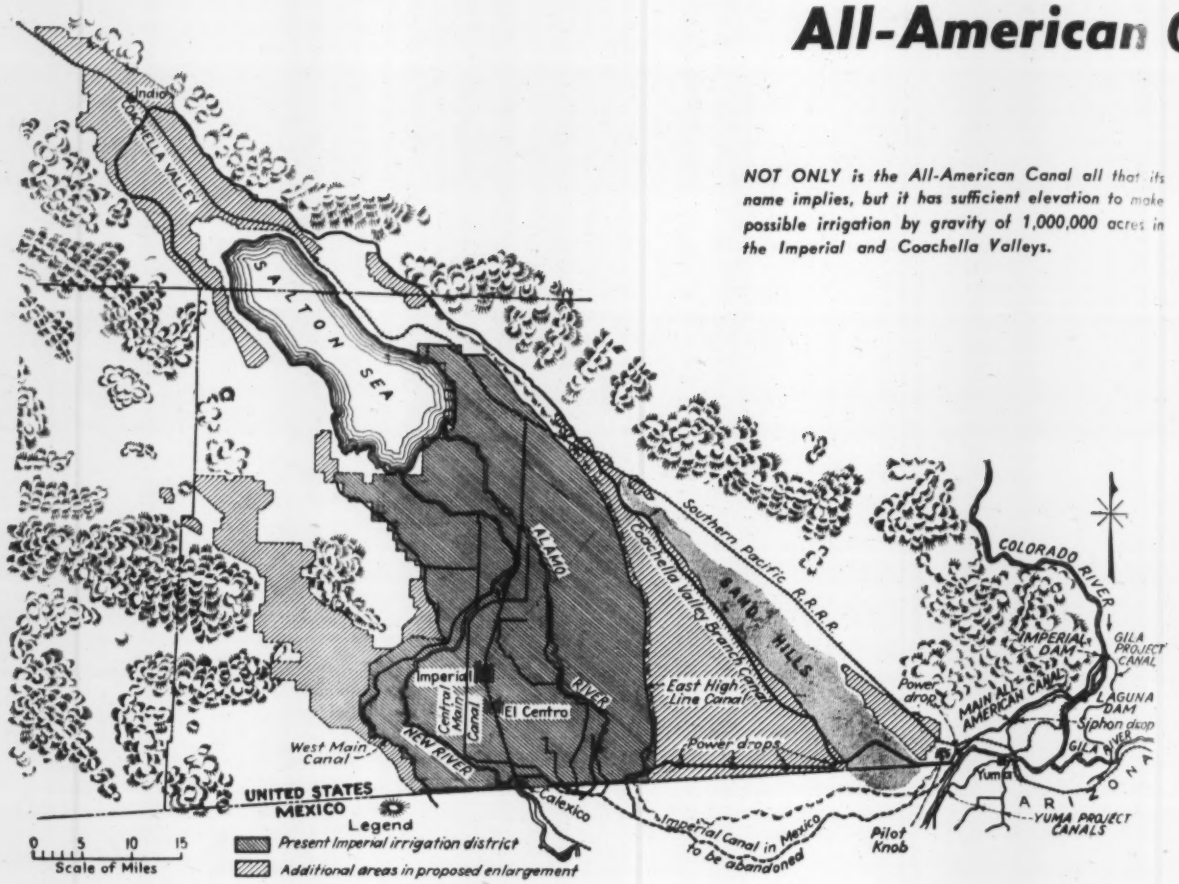
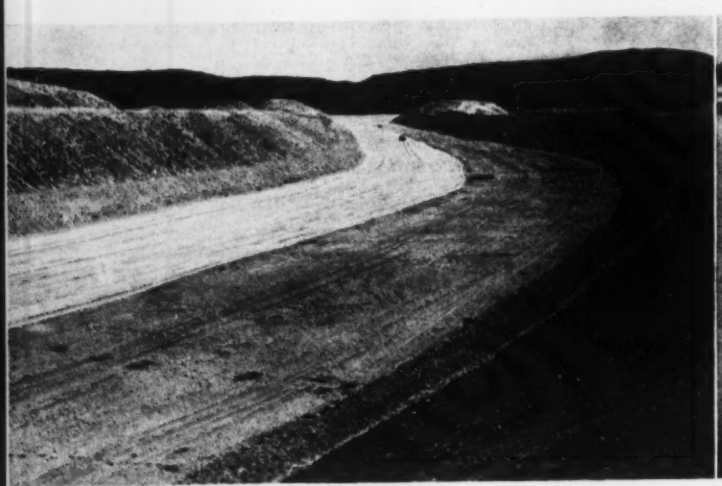
Builders organize at Birmingham, Ala.

The Co-operative Builders Association has been formed at Birmingham, Ala., with 52 contractors as members. A feature of the organization is the plan for all members of the association to back a contractor for a building project by the execution of a joint bond. Purpose of the organization is to reduce building costs, and to furnish prospective building owners with all essential information as to financing materials and workmanship.

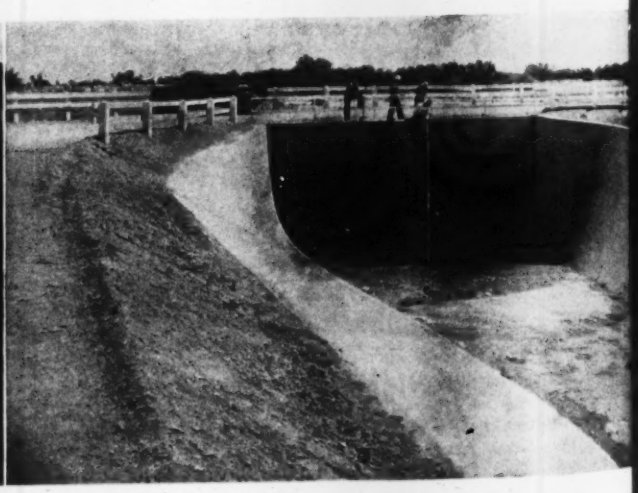
All-American Can

NOT ONLY is the All-American Canal all that its name implies, but it has sufficient elevation to make possible irrigation by gravity of 1,000,000 acres in the Imperial and Coachella Valleys.





LIGHTER AREA of bottom is rolled portion of a clay layer; dark area on near half of bottom is clay ready for rolling. Such lining was necessary when erodable silt forms the natural bottom.



SIPHON CONVEYING New River flow under canal is filled for first time. Water courses with flood flows greater than 300 cfs are bridged or siphoned across canal.

ady for use

Bureau of Reclamation ph

DARKENED areas on canal bottom shows sprinkling preparatory to rolling. At left is a sluiceway discharging into canal from a tributary drainage basin.

To SUPPLY Imperial Valley with Colorado River water without passing through Mexican territory, the $38,500,000 All-American Canal is to go into service this month. With the Imperial Canal completed in 1901 for the same purpose, rough terrain and shifting sand dunes too formidable for construction equipment of that day forced construction southward into Mexico. However, with such modern equipment as walking draglines operating 16-cu. yd. buckets at the end of 185-ft. booms available, the challenge of the rough desert country north of the international line was accepted when Congress Dec. 21, 1928 approved the All-American Canal work by passing the Boulder Canyon Project Act.

The 80-mile canal starts at Imperial Dam and terminates 10 miles west of Calexico, Calif. With a bottom width in its upper portion of 160 ft. and a top width of 232 ft. to provide a 21-ft. water depth, the canal gets smaller as side canals reduce the flow. From Imperial Dam to Siphon Drop, where 2,000 cfs will be diverted the canal's capacity is 15,000 cfs.

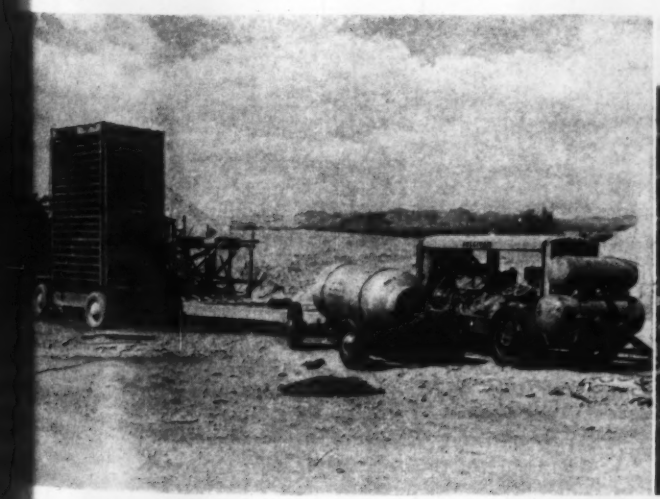
In addition to the existing Imperial District the All-American Canal will also supply water for the 130-mile Coachella Canal, which is still under construction. This canal will swing around the east side of the valley and north of Salton Sea to bring to about 1,000,000 acres the area north of the international boundary in the Imperial and Coachella valleys that could be irrigated.

Construction methods on the main canal are suited to the materials traversed. In portions through the fine silt that might be eroded, the section has been over-excavated and then lined with heavier material; porous sections are lined with selected materials trucked in and rolled into impervious layers.

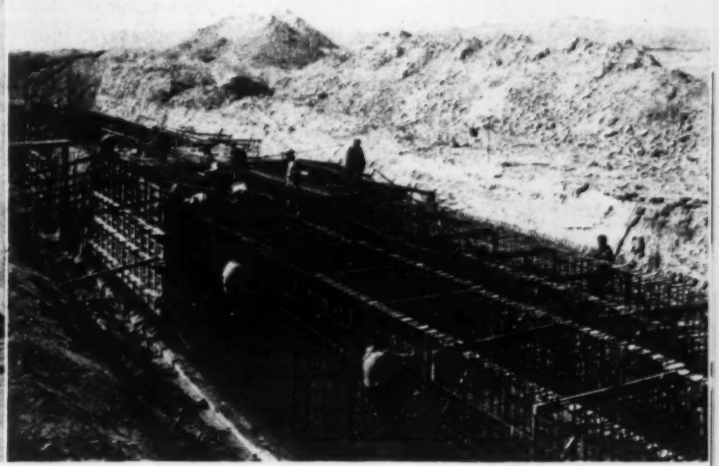
Difficulty with "blow" sand, if it develops, is to be controlled by vegetation, oil spray, or a covering of coarser material; where the hazard is greatest a 20-ft. berm is left along the canal rim. Through the sand dunes the mean flow velocity will be 3.75 ft. per sec., which is intended to be non-scouring and non-silting. Power will be developed at six of the seven "drops", as indicated on the accompanying map.

Latest reports are that seasoning of the canal, in preparation for delivery of 1,800 to 2,000 cfs to the existing East Side High Line Canal of the Imperial district, will start early this month. Several months may be required in the process of seasoning and gradually increasing the flow in the main canal, but when service to the East Highline starts, delivery to this canal via Mexico will end.

Construction is by contract under direction of the Bureau of Reclamation.



MOBILE CONCRETING equipment used on construction of Coachella main canal. At left is cooling tower to lower temperature of mixing water from 106 deg. F. to 70 deg.



STEEL REINFORCEMENT for a siphon barrel on the Coachella main canal, which is poured in 30-ft. sections. This canal, 130 miles long, will bring large new areas under irrigation.

Joins N.Y.U. faculty

Rolf Eliassen, who holds three degrees from Massachusetts Institute of Technology, including a doctor's in sanitary engineering, has been appointed associate professor of sanitary engineering in the college of engineering at New York University. In addition to his teaching duties, Eliassen will be in charge of the sanitary engineering research laboratory to succeed the late Lewis Van Carpenter. Investigation of sanitary land fills is an important laboratory study that will be continued.

For a time Eliassen worked with the consulting and sanitary engineering firm of J. N. Chester Engineers, Pittsburgh. From 1936 to 1939 he was associated with The Dorr Co., engineers and manufacturers, on research and development and in operation, design and construction of plants for the treatment of water, sewage and industrial wastes.

Bids asked for road work in Grand River Dam area

The Oklahoma State Highway Department has announced that bids will be received on Sept. 24 for the construction of a new bridge across the Grand River below Grand River Dam and for twin bridges at Wyandotte over the Neosho and Spring rivers. This work is made necessary to replace roads and bridges being inundated above the Grand River Dam, which is now nearing completion.

S. H. Singleton, chairman of the commission, reports that the total cost of the road work made necessary by the construction of the dam is estimated at $2,161,000. This is close to the estimate Gov. Phillips made earlier this year when he called out the National Guard in an effort to make the PWA pay for roads and bridges in the reservoir area. Eight bridges are included in the work, and there are five road projects on U. S. Highway 49, four on U. S. Highway 60 and five on State Highway 10. In addition there are seven farm-to-market jobs to join communities now cut off from one another by the rising waters of the Grand River.

BRIEF NEWS

SIX PERSONS were killed and several more injured Aug. 31 when two 20,000-gal. wood-stave water tanks fell through the roof of a two-story bath-house at Atlantic City, N. J. It has not been ascertained whether the accident was due to failure of the supports under the tank, the brick walls of the bath-house, or the tank itself. A coroner's jury has been named to investigate the accident.

OPENING of the Pennsylvania Turnpike is now set for Columbus Day, Oct. 12.

TIONESTA DAM, a $5,400,000 flood control project in western Pennsylvania on Tionesta Creek, was completed Sept. 1 eight months ahead of schedule. The dam, supplying storage space for about 177,000 acre ft., will control flow from a drainage area of 483 sq. mi.

THE $4,500,000 toll highway bridge over the Susquehanna River at Havre de Grace, Md. was dedicated Aug. 24.

THE AMERICAN SOCIETY of Civil Engineers has named Walter D. Binger as chairman of the society's new civilian defense committee. The committee was authorized at the recent meeting of the society in Denver, *ENR*, Aug. 1, p. 133. Binger is commissioner of borough works, Borough of Manhattan, New York. The committee will study methods of protecting civilians against bombing, also the protection of utilities in time of war.

COUNTY HIGHWAY maps showing all highways, industrial plants, railroads, roads and bridges and other engineering structures in rural areas will soon be available for all states, the Public Roads Administration announced last week. Already sheets covering 2,741 counties or about 90 per cent of the nation have been completed.

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Downer and Clarke named PRA consultants

Jay Downer, consulting engineer of New York City, and Gilmore D. Clarke, landscape architect and dean of the college of architecture at Cornell University, have been named consultants to the Public Roads Administration by Federal Works Administrator, John M. Carmody. The two men will study special highway, bridge and parkway projects and make reports with recommendations for their planning and development. Downer was chief engineer and Clarke landscape architect in the development of the Westchester County, N. Y., parkway system.

JOBS OF THE WEEK

POWDER PLANT, Parlin, N. J.

Hercules Powder Co., Wilmington, Del., will build with its own forces and day labor at Parlin, N. J., a nitro-cellulose manufacturing plant, estimated to cost $1,000,000. Five one-story buildings are planned.

WAREHOUSES, Jeffersonville, Ind.

George H. Rommel Co., Louisville, Ky., received a $1,262,800 contract, to construct 14 storage warehouses at the Quartermaster Depot at Jeffersonville.

SUBWAY, Brooklyn, N. Y.

George H. Flinn Corp., New York, N. Y., was low with a bid of $5,713,802 for constructing Section 10 of Route 110, of the Rapid Transit R.R. Work extends along Pitkin Ave from Crystal St. to Grant Ave. in Brooklyn. The Board of Transportation, New York City, is doing the work.

AIRCRAFT REPAIR SHOP, Mobile, Ala.

A. J. Rife Construction Co., Dallas, Tex., will construct $1,350,000 aircraft repair shop at the Southeast Airbase.

RECYCLING UNIT, Shreveport, La.

Hudson Engineering Co., Houston, Tex., will build a $1,250,000 recycling unit for the Cotton Valley Recycling Co., Shreveport, La. The work is part of project to cost $22,000,000.

PLANT, Stamford, Ontario.

Chemical Construction Co., a subsidiary of American Cyanamid Co., New York, was awarded a contract for constructing a $12,000,000 plant for the North American Cyanamid, Ltd., Niagara Falls, Ont. Findlay & Mann, Niagara Falls, Ont., are architects for the work.

Floods again hit North Carolina

Twelve inches of rain at Mt. Mitchell adds greatly to damage caused by floods two weeks previously

North Carolina's third destructive flood in less than a month struck the western section of the state Aug. 30, doing thousands of dollars worth of damage to highways, bridges and industrial plants.

It was the second flood in three weeks for the western section of the state, and again played havoc with many highways and bridges which had been repaired after having been damaged by high waters Aug. 14.

Washouts, landslides and high water halted traffic on nine principal highways in the area, and high waters roaring down the valleys washed away a number of secondary highway bridges, many of which had just been replaced after having given away in the August 14 floods. Wide areas were left isolated.

Preceding the floods were torrential rains, 12 in. being recorded at Mt. Mitchell during the 24-hr. period ending at 7:30 a.m., Aug. 30, with Asheville reporting 7 in., Waynesville 5.86 in., Rosman 6.84 in. and Swannannoa 7.4 in.

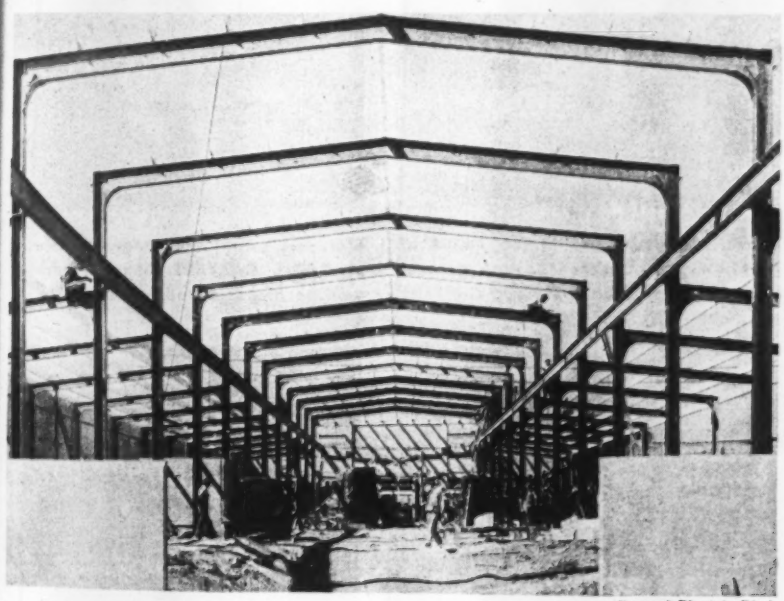
The floods affected only western North Carolina and southeastern Tennessee, and as the rains did not fall on watersheds of rivers in eastern North Carolina there was no danger of subsequent floods in northeastern section as was the case after the Aug. 14 floods.

Hardest hit was the town of Marshall, in Madison County, where the French Broad River rose six feet in the business section, sweeping away several small buildings, railroads and the center span of a river bridge. Electric light and telephone poles also were carried away, and the town left without drinking water or electricity. Many persons were driven from their homes.

At Enka, seven miles west of Asheville, waters of Hominy Creek flooded the American Enka Corp. plant, stopping operations and doing damage estimated at a half-million dollars. The floods came during the early morning hours and 1,000 workers on the night shift were trapped by the rising water and had to be evacuated by boats.

Flood waters inundated the business section of Canton to a depth of four feet and washed out a 200-ft. section of highway between Canton and Asheville. Traffic was disrupted on railroads linking

(Continued on p. 11)



General Electric Photo

Welded rigid frame bents for machine tool plant

Extensive use of rigid frames instead of the more conventional truss type framing characterizes a new 80 x 260 ft. plant for Harron, Rickard & McCone, machine tool firm in Los Angeles. Completely arc welded, the framing is arranged to span a main aisle 40 ft. wide and two side aisles of 20 ft. Design loads include a lateral force of 8 per cent of the vertical loads, which include those from a 5-ton crane. Under maximum load the calculated lateral deflection of the frames is 1 1/8 in. while the vertical deflection at the center of the wide span is 7/8 in.

The lower 4 ft. of the exterior wall is of concrete 8 in. thick, while the remainder of the wall height, 10 ft. 3 in., is of steel sash. The roof deck consists of 2 in. tongue and groove sheeting on 4 x 10 in. purlins on 4 ft. centers.

Hugo Eckert did the design work and the Associated Piping & Engineering Co., Los Angeles, the fabricating and welding.

Hurricane rain floods New Jersey

Small dam failures, bridge and fill washouts and general inundation occur in 200-sq. mi. area

Before veering off to sea and sparing Long Island and New England a repetition of the 1938 disaster, a tropical hurricane dragged its wet western edge over five counties, east and south of Camden, N. J., on Sunday, Sept. 1, causing floods that did estimated damage of $5,000,000. Full of Labor Day weekend visitors, the 200-sq.mi. area affected was spared a large loss of life—only five persons have been reported drowned—by virtue of prompt warning and action by weather authorities, the state police, the state highway department, and local officials. As it was, 100,000 persons were marooned for 8 hr. in Atlantic City when roads and railroads to Philadelphia and New York were washed out. Greatest rainfall reported for the storm was 6½ in. in 17 hr.

Small dams wash out

Some of the most serious stream damage occurred on Great Egg Harbor River when small dams at Grenloch and Blackwood, 12 miles southeast of Camden, went out; buildings and bridges were crushed by the water and railways and highways were washed out. Another dam on the Cohansey River at Bridgeton released water that wrecked two of the three bridges that give access to the town.

About one-half million dollars damage was done to state highways, it is reported. Only two state highway bridges were lost, according to Morris Goodkind, bridge engineer: a 50-ft. plate girder span over Salem Creek at Woodstown is minus an abutment and its deck, while a 16-ft. brick arch over Raccoon Creek at Mullicahill was destroyed. Bridge damage on county highways was much more extensive although all structures were small.

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A.G.C. cancels meeting scheduled for Santa Fe

The fall meeting of the Associated General Contractors of America, scheduled for Santa Fe, New Mexico, Sept. 30-Oct. 2, has been cancelled because of the emergency condition now affecting the construction industry and the national A.G.C. staff at Washington. Nominations for president and vice-president of the association for 1941, which were to be made at the Santa Fe meeting, will be handled by the governing board. The next meeting of the A.G.C. will be the annual convention scheduled for Houston, Texas, next February.

Acting as chairman of the general convention committee is extra-curricula activity for GEORGE SCHROEPFER, who is the energetic engineer of the Minneapolis-St. Paul Sanitary District.

Working hard on publicity is ANTHONY ANABLE, advertising manager of The Dorr Co.

MEN AT WORK

ON SANITARY ENGINEERS MEETING

Here we have the committee chairmen who are preparing plans for the first annual convention of the Federation of Sewage Works Associations, which is to be held in Chicago on Oct. 3-4-5.

Financial matters are in the hands of WILLIAM ORCHARD, genial general manager of Wallace & Tiernan Co.

Worrying about the program is the job of CECIL CALVERT, superintendent of sewage disposal, Indianapolis.

Local arrangements are in the hands of F. W. MOHLMAN, chief chemist, the Sanitary District of Chicago.

Keeping everybody happy with entertainment falls to the lot of H. E. SCHLENZ, Pacific Flush Tank Co.

Manufacturers and exhibitors get their cue from O. T. BIRKENESS, of the Chicago office of Wallace & Tiernan Co.

MEN AND JOBS

Capt. Carl A. Carlson, civil engineering corps, U. S. Navy, has been ordered detached from duty as general inspector and procurement officer for the Public Works, 11th, 12th and 13th Naval Districts. Capt. Carlson was placed on the retired list of officers of the U. S. Navy August 1.

Lieut. Cmdr. Collins Lee Macree, civil engineering corps, U. S. Navy, previously ordered detached from duty from the 12th Naval District on or about July 1 to the retired list of officers, has been ordered to continue on active duty in the 12th Naval District following his retirement. Leslie W. Mahone, formerly assistant professor in the engineering extension service at Iowa State College, has opened an office at Des Moines, Ia., to head the state of Iowa's new merit rating system. He will give merit rating examinations to 1,600 Iowa employees of the federal-state governmental units.

Jacques Limoges, civil engineer, has been appointed district engineer for the Quebec department of roads. He will be located at Quebec.

Jean Paul Carriere, civil engineer, recently was appointed senior assistant engineer at the Montreal, Ont., office of the federal department of public works.

A. J. Richardson has been appointed chief engineer of the Dominion Atlantic R. R. of Canada, replacing G. W. Griffin.

T. J. Palm, of Waco, Tex., has begun new duties as engineer of McLennan County, Tex., with headquarters at Waco. He succeeds D. W. Porter, who has resigned to accept a position at Corpus Christi, Tex.

Robert Lealand Hunter, architect of Fort Worth, Tex., has been named executive director of the Fort Worth Housing Authority. He succeeds Honer A. Hunter, his brother, who resigned to become assistant city engineer of Dallas, Tex.

Paul Rossiter has been appointed city engineer and building commissioner at Forest City, Iowa, to succeed Harry H. Howie, who has resigned to become associated with his father, David T. Howie, building contractor of that city.

Maj. Karl B. Schilling, project engineer in charge of construction of Sardis Dam for the U. S. Engineers since January, 1939, has been named acting district engineer of the Vicksburg District to succeed Col. Raymond G. Moses, who has been transferred to Fort Belvoir, Va.

Lieut. William B. Milne, for the past two years executive officer of the Memphis District, U. S. Engineers, has gone to Fort Bragg, N. C., where he will be assigned to the 15th Engineers in the Ninth Division. Lieut. Miller went to Memphis following studies at Cornell University. He graduated from West Point in 1936. His old duties are to be taken over by Maj. Harry Meyer, who has also been stationed at Memphis, being in charge of flood control work.

TVA's engineering staff at the Cherokee Dam work will include Lee G. Warren, project manager; George K. Leonard, construction engineer; G. E. Murphey, construction superintendent; T. F. Taylor, assistant construction engineer; O. A. Nystrom, project accountant, and J. W. Clarke, field engineer. For the Watts Bar work, Fred C. Schlemmer, is project manager of the dam and steam plant; F. E. Bell, construction engineer of the steam plant; Orin Reed, construction engineer of the dam; J. S. Lewis, construction superintendent; and H. T. Lofft, assistant construction engineer of the dam. At Fort Loudoun E. C. McClenagan will be construction superintendent; F. L. Weiss, field engineer, and C. C. Cullum, office engineer; Clarence E. Blee, project manager, and J. F. Partridge, assistant construction engineer. A. M. Komora has been appointed assistant construction engineer for the Wheeler and Wilson projects. H. B. Vasey has resigned as assistant office engineer with the TVA to become city manager of Montrose, Colo.

B. E. Roberts, formerly with the city engineering department at LaGrange, Ga., has been appointed engineer of Troup County, Ga., to succeed William Hunter, resigned. Roberts has worked as a civil engineer in many sections of western Georgia and Florida.

James B. Marshall, former city manager of Charlotte, N. C., Sept. 1 began new duties as executive vice president of the Goode Construction Corp., Charlotte. Marshall resigned as city manager at Charlotte on June 1 to join the Morgan Heater Co. For six years prior to 1917 he was associated with Gilbert C. White, consulting engineer of Durham, N. C. Moving to Charlotte in 1917 he was made vice president of the engineering firm of Tucker & Laxton, and was named city manager of Charlotte in 1935. In his new work he will work with Roy L. Goode, president of the Goode firm.

O. Bessette, civil engineer, formerly city engineer at St. Johns, Que., and at Valdor, Que., is now working for the Canadian war supply board as inspector of materials and controller of production for eastern Canada.

J. Lefebvre, who graduated in civil engineering from the Ecole Polytechnique in 1934, is now working at Bogota, Columbia, with the Tropical Oil Co. as technical adviser on road construction.

G. Dufour, who graduated from the Ecole Polytechnique of Montreal in 1937 as a civil engineer, is now employed at Arvida, Que. by the Aluminum Co. of Canada.

J. P. Leroux, who graduated in civil engineering from the Ecole Polytechnique in 1939, is now resident engineer on the construction of the St. Johns airport near Montreal.

Charles H. Jackson, civil engineer, former production manager of the ammunition division of the Canadian Industries Limited, is now manager of the same division.

J. E. A. Gibeault, civil engineer, recently began new duties as assistant superintendent of the Atlantic Division of the Canadian National Ry. with offices at Moncton, N. B. Gibeault, who graduated from the Ecole Polytechnique at Montreal in 1910, joined the Canadian National that same year. In 1927 he was appointed superintendent at Levis, Que. and in 1931 superintendent at Montreal, Que. In 1932 he was made superintendent at Campbellton, N. B.

Waldo E. Smith has accepted a civil service appointment as hydraulic engineer with the Soil Conservation Service on flood control work for the Department of Agriculture. Smith, who began his new duties Aug. 1 at Washington, D. C., was formerly the hydraulic engineer of the Muskingum Watershed Conservancy District. He had charge of the flood control operation planning for the district until last October.

K. Sewell Wingfield, chief project engineer for the PWA in Nebraska, has been transferred to Washington, D. C. to be chief engineer of the PWA power division. Wingfield served as assistant director of the power division at Washington before going to Nebraska in 1937. His place in the Kearney office will be taken by Douglas Wright, assistant project engineer.

OBITUARY

LESTER T. BRECKENRIDGE, 82, professor emeritus of mechanical engineering at Sheffield Scientific School, Yale University, died Aug. 23 in North Ferrisburg, Vt. Most of his life has been devoted to teaching at the University of Illinois where he was professor of mechanical engineering from 1893 until 1909, and at the Sheffield Scientific School where he remained actively teaching until 1923.

WILLIAM BOWIE, 68, retired chief of the Division of Geodesy of the Coast and Geodetic Survey, died last week at a Washington hospital. Bowie entered the service of the Coast and Geodetic Survey in 1895, being appointed chief of the Division of Geodesy in 1909, holding this position until his retirement in 1936. He has been honored with degrees and awards by educational, scientific, and governmental agencies in this country and abroad, and has written extensively on geodesy and isostasy. He had recently been appointed editor of *The Military Engineer*.

GEORGE T. PORMIER, highway commissioner of Brown County, Wis., died Aug. 17 of injuries received while on an inspection trip to a road grading job.

PATRICK F. MCCARTHY, 68, chairman of the board of the McCarthy Improvement Co., Davenport, Iowa, died in that city on Aug. 23. McCarthy had been engaged in the contracting business for more than 40 years, his company being well known throughout the eastern half of the United States.

ALBERT H. LEIBBRAND, 66, retired general contractor and builder, died at his home in Columbus, Ohio, Aug. 20.

EDWARD SIMONSON, 69, construction superintendent for the firm of R. T. Wieboldt Co. of Chicago, died Aug. 26.

LOUIS A. FERGUSON, 73, vice-president in charge of engineering and construction of the Commonwealth Edison Co. of Chicago, until his retirement in 1936, died at Rhinelander, Wis., Aug. 25. Ferguson was a past president of the American Institute of Electrical Engineers and the National Electric Light Association.

HARRY E. GOULD, 61, general contractor in Wilkes-Barre, Pa., for the past 20 years, died Aug. 24 at his home in that city.

JAMES A. HAYLOW, 70, civil engineer, who was construction and chief engineer on the first street railway lines in Memphis, Tenn., died there Aug. 28.

PARKER W. THOMPSON, chief inspector for Birmingham (Alabama) Waterworks Co., and connected with that organization for the past 31 years, died in Birmingham Aug. 30.

HULBERT J. CLARK, 52, died at his home in Oklahoma City on Aug. 23 after serving 20 years as chief engineer of the Oklahoma inspection bureau.

DONALD T. NUGENT, assistant county engineer of Kossuth County, Iowa, for 15 years, died recently.

FRANK DEBOUT, 74, a member of the Pennsylvania Turnpike Commission, died at Harrisburg on Aug. 22 following a heart attack. Debout had been a member of the commission since its organization in 1937.

THOMAS W. RICHARDS, 4[illegible] builder and president of the Erie Construction & Excavating Co., died Aug. 28 in Garfield Heights, Ohio.

HARRY E. LISTER, 74, a retired civil engineer, died Aug. 29 in Monmon, Ind.

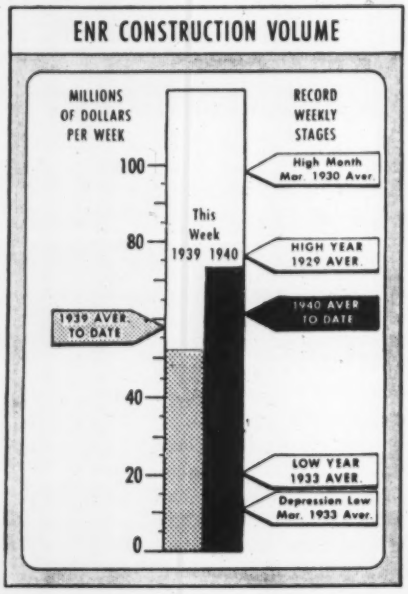
CONTRACTS AND CAPITAL

CONTINUATION of defense spending brings engineering construction awards for the short week due to the Labor Day holiday to $76,561,000, 47 per cent higher than the total for the corresponding 1939 week.

Increased volumes in commercial and industrial building are responsible for a 34 per cent gain in private construction, and public building is the most important factor in public construction's 52 per cent gain over a year ago.

The week's total brings 1940 construction to $2,211,282,000, a gain of 5 per cent over the $2,107,921,000 reported for the 36-week period last year. Private awards are up 17 per cent. Public construction for the first time passes its 1939 mark, due directly to the 164 per cent gain in federal work.

In the classified construction groups gains over last year are recorded in waterworks, bridges, industrial, commercial and public buildings, earthwork and drainage, and streets and roads. Increases over the preceding week are in sewerage, bridges, commercial and public buildings, earthwork, and highways.



New capital for construction purposes for the week totals $445,947,000. This compares with $4,508,000 for the 1939 week. The current week's large volume is due primarily to the $390,000,000 appropriation for WPA construction. In addition to this federal money, there is $51,878,000 in USHA loans, $4,032,000 in state and municipal bonds, and $[illegible],000 in RFC public loans.

As a result of the week's high financing total, construction capital for the 36 weeks of 1940, $2,431,278,000, tops the volume for the period a year ago by 13 per cent.

CONTRACTS

(Thousands of dollars)

	Week Ending Sept. 7 1939	Aug. 29 1940	Sept. 5 1940
Federal	$6,290	$8,452	$[illegible]
State & Municipal	32,329	28,674	[illegible]
Total public	$38,619	$37,126	$[illegible]
Total private	13,387	20,318	[illegible]
TOTALS	$52,006	$57,444	$76,561
Cumulative			
1940	(36 weeks)		$2,211,282
1939	(36 weeks)		$2,107,921

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial building, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1939 36 Wks.	Cumulative 1940 36 Wks.
NON-FEDERAL	$1,026,220	$1,232,706
Corp. Securities	175,314	158,289
State & Mun.	406,754	603,851
R.E.A. loans	89,445	[illegible]
U.S.H.A. loans	160,852	179,579
R.F.C. loans	3,855	116,196
Fed. Air-Hwy.	190,000	184,000
FEDERAL	$1,128,028	$1,198,572
TOTAL CAPITAL	$2,154,248	$2,431,278

FHA MORTGAGES

	Week Ending Sept. 2 1939	Aug. 24 1940	Aug. 31 1940
Selected for appraisal	$22,386	$28,429	$28,127*
Cumulative			
1940	(35 weeks)		$876,590*
1939	(35 weeks)		$788,865

* Subject to revision.

ENR INDEX NUMBERS

Index Base = 100	1913	1926
Construction Cost	Aug. '40 .. 212.18	116.42
Building Cost	Aug. '40 .. 201.71	109.08
Volume	July, '40 .. [illegible]	135

MEETINGS

AMERICAN ASSOCIATION of State Highway Officials, annual convention, Seattle, Wash., Sept. 15-19.

FEDERATION OF SEWAGE WORKS ASSOCIATIONS, first national convention, Chicago, Oct. 3-5.

NATIONAL SAFETY COUNCIL, national safety congress and exposition, Chicago, Oct. 7-11.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Detroit, Mich., Oct. 8-11.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago, October 15–17.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Cincinnati, Ohio, Oct. 16-18.

AMERICAN WELDING SOCIETY, annual meeting, Cleveland, Ohio. Oct. 20-25.

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Big sewer bond issue upheld in Philadelphia

Constitutionality of a proposed $42,000,000 bond issue to pay for improvements to the sewer system of the city of Philadelphia has been upheld by the courts of that city. The ruling is the result of a friendly suit to clear up any question of the legality of the issue before the bonds were offered for sale. An appeal will be taken immediately to the Pennsylvania State Supreme Court. If upheld there, the proposed bond issue will be submitted to the voters at the Nov. 5 election.

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North Carolina floods

(Continued from p. 7)

Asheville and Knoxville, Tenn., and Asheville and Murphy, N. C.

Prior to the latest floods, W. Vance Baise, chief engineer of the North Carolina highway and public works commission had estimated that the previous high waters in the western and northeastern section had caused damage to highways and bridges between $4,300,000 and $5,250,000. Although declaring that his estimate of damage was largely a "guess" in regard to secondary roads, Baise said it was this part of the system that had suffered the most and that it would cost from $2,500,000 to $3,000,000 to replace material washed away.

The washing away of a three-and-a-half-mile fill on U. S. Highway No. 17 in Martin County caused damage estimated at $498,000 Baise declared. A 20-mile stretch of U. S. 221 in McDowell County between Linville Falls and Marion was estimated to have been damaged in the amount of $72,820, and the damage to a 20-mile stretch of U. S. 421 between Deep Gap and Millers Creek in Wilkes County was estimated at $142,560. These counties were the hardest hit in the first two floods and the North Carolina Highway Commission already has applied to the Federal Public Roads Administration for $356,000 for use in repairing damage in these areas. The amount is half the amount of estimated damage in the three counties and is sought under laws allowing use of federal funds in repairing federal-aid highways damaged in such disasters.

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Adequate research begun

Effect of aggregates on the durability of concrete will be the subject of research by a fellowship at the University of Maryland established through cooperation of the University and the National Sand & Gravel Association. Fred F. Bartel, University of Wisconsin, has been selected as holder of the fellowship. Principal object of the research will be gravel consisting mainly of chert.

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Arizona seeks Colorado River water

Proposed $15,000,000 project includes construction of 190-mile aqueduct

Arizona's first serious attempt to obtain water from the Colorado River was launched last week when officials of the central Arizona irrigation districts and municipalities took preliminary steps in organizing the Central Arizona Water Authority. The purpose of the new organization is to bring 1,000,000 acre-ft. of water from the Colorado River to central Arizona by construction of a 190-mile aqueduct.

An outstanding feature of the $15,000,000 project, which is expected to deliver water to central Arizona for $2.20 per acre-foot, is the fact that less than two miles of the total of 190 miles of aqueduct will require tunneling.

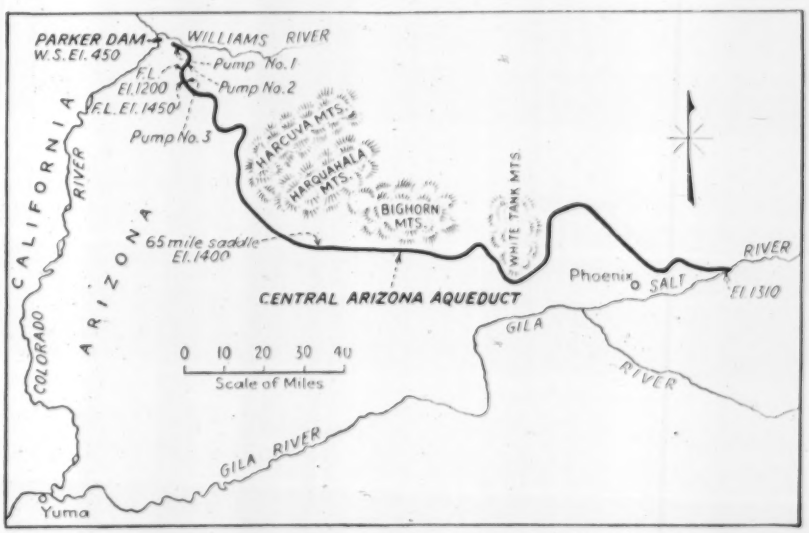
Three pumping lifts required

The intake pumping plant will be located on the east bank of Havasu Lake, which is formed by Parker Dam, with the water lifted 400 ft. to a line to extend across a talus slope and eastward up the Williams River for 8 miles. At this point a second pumping plant will be constructed to lift the water over a local summit to a line that extends roughly 6 miles to the third pumping plant, where the water will be pumped to its maximum height to flow by gravity for the remaining distance. The line runs generally southward along the base of the Harcuva Mountains to mile 65, from where it turns eastward through a saddle and proceeds along the base of the Harquahala, Big Horn, and White Tank mountains to the present irrigated lands in the Salt River Valley in central Arizona.

The total pumping lift will be 1,000 ft., of which 200 ft. represents friction loss in the aqueduct and structures. When operating at full capacity, 190,000 hp. will be required to drive the pumps. Power is to be obtained from Boulder Dam. Capacity of the aqueduct would be 1,400 cfs.

Enabling legislation being drafted

Since the project will require enabling legislation to form the Central Arizona Water Authority, attorneys are now drafting a bill to be presented to the state legislature, which meets Jan. 1, 1941. With the passage of this enabling legislation, it is planned to award the first contract about May 1941, with construction to require about 18 months.



Where the aqueduct to bring Colorado River water to Arizona would be located.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

ARKABUTLA DAM MISSISSIPPI

OWNER: U. S. Engineer Office, Vicksburg, Miss.; Lt. Col. Raymond G. Moses, district engineer.

PROJECT: Construction of Arkabutla Dam for flood control, a rolled earth fill type structure, on Coldwater River in Tate and DeSoto Counties, Miss., seven miles northeast of Prichard. Dam approximately 10,000 ft. long, excluding north ridge dikes. Average height above valley floor 65 ft. Top width of embankment 40 ft. Outlet structure of gated type to be constructed in vicinity of existing stream channel, and spillway of chute type will be built.

CONDITIONS: Contractor to furnish all materials and complete work in 800 calendar days, without interference to other contractors who may have work at site. Railroad and highway transportation facilities available. Minimum wage rates specified are: skilled labor, 75c. to $1.00 per hr.; semi-skilled, 40 to 60c.; and common, 30c. Absorptive form lining ½-in. thick to be used in all walls of intake structure that are visible after work is completed; inside and outside walls of operating house, pier and abutment of service bridge, and all surfaces of spillway and outlet structures forming part of water passages also to be lined with absorptive material.

BIDS: Two bids were opened May 24, 1940, the contract low of $5,158,158, and $5,546,047. Contract awarded July 6.

LIST OF BIDDERS:

1. Forcum-James Co., Pioneer Contr'g. Co., H. N. Rodgers & Sons Co., Dyersburg, Tenn. (contract) $5,158,158
2. W. E. Callahan Constr. Co., Dallas, Tex. 5,546,047

Item	Quan.	Unit Prices (1)	(2)
1. Diversion and care of river	L. S.	$60,000.00	$51,250.00
2. Cofferdam No. 1	10,300 l. f.	8.00	5.00
3. Cofferdam No. 2	2,800 l. f.	20.00	12.50
4. Stripping for embankment	226,000 c. y.	.30	.28
5. Excav., exploration trench	18,500 c. y.	.30	.15
6. Excav., outlet structures	274,000 c. y.	.65	.43
7. Excavation, spillway	3,250,000 c. y.	.26	.28
8. Excav., drainage ditches	10,030 c. y.	.50	.50
9. Excav., impervious borrow	2,369,000 c. y.	.24	.22
10. Excav., pervious borrow	964,000 c. y.	.56	.57
11. Ful, compacted impervious	3,339,000 c. y.	.03	.115
12. Fill, compacted pervious	686,000 c. y.	.03	.105
13. Fill, uncompact. unclass	158,300 c. y.	.015	.05
14. Backfill, impervious	2,800 c. y.	1.00	2.12
15. Backfill, pervious	117,100 c. y.	.40	.48
16. Sand ballast, intake struct	520 c. y.	2.00	2.65
17. Topsoil	156,500 c. y.	.25	.40
18. Spot sodding	369,900 s. y.	.04	.02
19. Strip sodding	19,150 s. y.	.08	.08
20. Gravel, graded	2,830 c. y.	2.50	2.70
21. Gravel, ungraded	66,000 c. y.	2.00	2.30
22. 12-in. channel pipe	2,400 l. f.	.90	.60
23. 18-in. channel pipe	810 l. f.	1.50	1.20
24. 24-in. channel pipe	740 l. f.	2.00	1.60
25. 30-in. channel pipe	950 l. f.	4.00	2.70
26. 36-in. channel pipe	130 l. f.	6.00	3.60
27. 12-in. sewer pipe	2,485 l. f.	1.40	1.40
28. 15-in. sewer pipe	670 l. f.	1.50	1.60
29. 18-in. sewer pipe	225 l. f.	2.00	2.00
30. 21-in. sewer pipe	240 l. f.	2.50	2.40
31. Sew. pipe reducers 15- to 12-in	17 ea.	10.00	5.00
32. 12-in. corr. met. pipe	1,300 l. f.	2.00	2.70
33. Seepage well system	L. S.	30,000.00	33,000.00
34. Riprap paving	11,270 c. y.	6.00	9.20
35. Dumped riprap	146,000 c. y.	5.50	6.00
36. Derrick stone	12,150 c. y.	6.00	8.50
37. Grouting riprap paving	310 s. y.	6.00	1.20
38. Steel sheet piling	68,450 s. y.	1.15	1.26
39. Portland cement	64,230 bbl.	2.65	2.44
40. Porous concrete	3,570 c. y.	7.50	6.30
41. Conc., outlet str. intake	5,730 c. y.	16.00	14.40
42. Conc., outlet str. transition and conduit	3,620 c. y.	16.00	15.00
43. Conc., out. str. appr. channel pav. and stilling basin	4,140 c. y.	12.00	12.35
44. Conc., gate guide recesses	37 c. y.	40.00	40.00
45. Conc., spillway weir, chute slabs, still. basin floor	22,500 c. y.	10.00	8.50
46. Conc., spillway appr. slabs	5,250 c. y.	10.00	9.80
47. Conc., spillway walls	9,850 c. y.	14.50	12.00
48. Conc., misc. structures	220 c. y.	25.00	34.00
49. Conc. reinf. steel	4,973,000 lb.	.04	.043
50. Rubber water stops	1,400 l. f.	1.00	1.20
51. Copper water stops	21,300 lb.	.50	.48
52. Service bridge, struct. steel	52,000 lb.	.09	.08
53. Bridge railing	L. S.	2,500.00	3,250.00
54. Misc. metalwork	73,300 lb.	.15	.13
55. Gratings, drop inlet	29 ea.	20.00	15.00
56. Brass and bronze	320 lb.	1.25	1.00
57. Wrought iron pipe	41,000 lb.	.20	.20
58. Black steel pipe	29,100 lb.	.15	.10
59. Cast iron pipe	2,100 lb.	.15	.10
60. Rigid metal elect. conduit	8,330 lb.	.30	.30
61. Conduit lining	L. S.	30,000.00	34,000.00
62. Gates and accessories	L. S.	90,000.00	108,000.00
63. Operating house superstruct	L. S.	28,000.00	27,000.00
64. Water level recorders	2 ea.	250.00	450.00
65. Emergency power set	L. S.	5,000.00	5,000.00
66. Traveling crane	L. S.	9,000.00	10,000.00
67. Trolleys and chain hoist	L. S.	500.00	300.00
68. Stiff leg derrick	L. S.	3,000.00	2,000.00
69. Power and lighting system	L. S.	14,000.00	14,000.00
70. Bridge floor	28,800 lb.	.10	.12
71. Flagpole	L. S.	250.00	200.00
72. Operator's quarters	L. S.	20,000.00	18,000.00
73. Engineer. field officer	L. S.	30,000.00	30,000.00
74. Gaging station in outlet channel	L. S.	3,500.00	5,000.00
75. Stage gages	100 l. f.	6.00	5.00
76. Drilling and casing well	200 l. f.	5.00	5.00
77. Deep well pump, accessories	L. S.	2,400.00	2,000.00

HIGHWAYS, TEXAS

OWNER: Texas State Highway Department, Austin. Oscar A. Seward, Jr., Groesbeck, Tex., engineer.

PROJECT: Grading and drainage structures on U. S. 84 from McLennan-Limestone County Line to 12.462 miles west of Mexia. Total length 10.965 miles.

CONDITIONS: Contractor to furnish all materials and complete work in 240 working days. Rail and highway transportation facilities available. Wages specified are: skilled, $1.00 per hr.; semi-skilled, 50c. per hr.; and common, 40c per hr.

LIST OF BIDDERS (July 23, 1940):

1. Cage Bros. & F. M. Reeves & Sons, Bishop, Tex. (contract) $141,077
2. R. W. Briggs & Co., Pharr, Tex. 143,067
3. H. L. Butler, Dallas, Tex. 143,910
4. E. W. Hable, Corsicana, Tex. 149,673
5. M. E. Ruby and Wallace & Bowden, Dallas, Tex. 149,797
6. Southern Contr. Co., and Jensen Constr. Co., Austin, Tex. 155,489
7. Froemming Bros., Milwaukee, Wis. 156,581
8. Holland Page, Austin, Tex. 157,716
9. Austin Bridge & Road Co., Dallas, Tex. 165,091
10. Standifer Bros. and R. B. Butler, Bryan, Tex. 167,800
11. Ben Sira & Co., Dallas, Tex. 173,527

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear and grub	28.931 ac.	$35.00	$50.00	$25.00
2. Common road excavation	191,369 c. y.	.15	.13	.14
3. Common borrow	61,724 c. y.	.15	.13	.12
4. Common channel excav	50,793 c. y.	.15	.13	.14
5. Uncl. str. excav., culverts	1,267 c. y.	.10	.63	1.00
6. Uncl. str. excav., bridges	150 c. y.	.10	1.05	1.00
7. Blading embankment	793 hr.	2.50	.10	3.00
8. Overhaul	1,250,924 y. qtr.	.01	.017	.015
9. Sprinkling	6,345.9 M gal	.85	1.10	1.25
10. Rolling	1,480.5 hr.	3.50	3.50	3.00
11. Rolling	66 hr.	3.00	3.00	3.00
12. Scarify exist. pavement	34.65 sta.	4.00	3.00	2.50
13. Roadbed treatment	2,075 c. y.	1.60	2.00	1.50
14. Class A conc., culverts	1,792.53 c. y.	17.30	17.32	16.67
15. Class A conc., bents and abut.	37.98 c. y.	18.50	17.32	17.50
16. Cl. A conc., girders and slabs	172.95 c. y.	18.50	17.32	19.00
17. Reinforcing steel	300,686 lb.	.0475	.04	.04
18. Structural steel	1,390 lb.	.10	.10	.075
19. Cast steel bearing plates	2,760 lb.	.15	.13	.11
20. 18-in. corr. galv. metal pipe	30 l. f.	3.00	2.00	2.25
21. 24-in. corr. galv. metal pipe	30 l. f.	3.50	3.00	2.50
22. Remove old structure	1 ea.	75.00	25.00	10.00
23. 18-in. sq. precast conc. test piling	40 l. f.	5.00	5.25	5.15
24. 18-in. sq. precast conc. piling	360 l. f.	4.00	4.20	5.15
25. 15-in. sq. precast conc. piling	420 l. f.	3.00	3.67	4.05
26. Railing, type P	242.92 l. f.	4.00	2.90	3.30
27. Dry riprap, type A	240 c. y.	5.00	5.25	3.50
28. Grouted riprap, type A	10 c. y.	10.00	10.50	3.50
29. Common mortar riprap	430 c. y.	7.50	6.30	6.00
30. Spot sodding	32,288 s. y.	.025	.03	.02
31. Block sodding	1,602 s. y.	.20	.20	.25
32. Grass retards	4,981 c. y.	1.15	1.25	1.50
33. Right-of-way markers	198 ea.	1.50	1.05	1.35
34. Obliterate abandoned road	11.825 sta.	4.00	3.00	15.00